

Denys Rozumnyi

Curriculum Vitae

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Education

- Sep 2019 – **ETH Zurich, PhD Student**, Supervisor: Marc Pollefeys, Computer Vision and Geometry Group.
Present **Topics:** 3D reconstruction of objects and scenes, object detection, tracking, 6D pose estimation, and deblurring. The central contribution of my PhD thesis is a general framework to solve all these tasks together. For that, I utilized neural rendering and test-time optimization, and I'm passionate about these two tools (alongside deep learning). I designed a pipeline [11,13,15] to minimize a loss on reconstructing the input image via differentiable rendering with suitable regularizers, which led to high-quality 3D reconstruction and plausible novel view synthesis (similar to NeRF and Gaussian Splatting). I extended this pipeline to improve unknown object tracking by 3D reconstruction on the go [16]. These methods are open-sourced [GitHub].
- Jul 2017 – **Czech Technical University in Prague, Master of Science (with honours)**, Specialisation: Computer Vision and Image Processing, Artificial Intelligence, Average grade: 1.10/1.00.
- Oct 2018 – **Technical University of Munich, Erasmus+ Student Exchange Programme**, Master of Science in Computer Science.
- Sep 2014 – **Czech Technical University in Prague, Bachelor of Science (with honours)**, Specialisation: Computer Science and Mathematics, Average grade: 1.08/1.00, 2nd best graduate of the year.
- Sep 2016 – **Swansea University, Wales, United Kingdom, Erasmus+ Student Exchange Programme**, Bachelor of Science in Computer Science.

Work experience

- Oct 2023 – **PhD Research Scientist Intern, Meta Zurich**.
Mar 2024 **Topics:** Worked on 'XR-MBT: Multi-modal Full Body Tracking for XR through Self-Supervision with Learned Depth Point Cloud Registration' [20] – a generative diffusion-based approach for egocentric body tracking from upper body tracking signals and egocentric depth maps.
- Oct 2022 – **PhD Student Researcher, Google Zurich**, Supervisors: Vittorio Ferrari, Stefan Popov.
Jul 2023 **Topics:** Worked on 'Estimating Generic 3D Room Structures from 2D Annotations' [17] – a novel method to produce generic 3D room layouts just from 2D segmentation, worked with a large pool of annotators (20+), and also released a new dataset [GitHub].
- Mar 2018 – **Research Fellow, CTU in Prague**, Visual Recognition Group, Supervisor: Jiri Matas.
Present **Topics:** On-going collaboration on visual object tracking [6,7,8,10,12,16]. One of my most successful projects was the first learning-based method for deblurring and shape recovery of fast moving objects [9]. I trained a novel deep-learning based model with novel loss functions tailored for this task. This method has a wide range of applications, e.g. to debunk UFO footage [news, GitHub].
- Jul 2018 – **Student Summer Research Fellowship, ETH Zurich**.
Aug 2018 **Topics:** Worked on 'Learned Semantic Multi-Sensor Depth Map Fusion' [5] during this highly prestigious fellowship with an acceptance rate of around 1% (accepted 15 students out of 1400 applications worldwide). Supervisors: Marc Pollefeys, Martin Oswald.
- Aug 2017 – **Summer Internship, Tampere University of Technology**, Tampere, Finland.
Sep 2017 **Topics:** Worked on a real-time demo in C++ for fast moving objects detection [GitHub] based on my CVPR'17 paper [2]. Supervisors: Jiri Matas, Joni Kämäräinen.
- Sep 2016 – **Research Intern, CTU in Prague**, Visual Recognition Group.
Feb 2018 **Topics:** Worked on my Bachelor thesis supervised by Jiri Matas, which was published at CVPR'17 [2]. We were the first ones to notice and introduce fast moving objects in images/videos. I was the main driving force of this project, in which we defined the problem, created new datasets, proposed a baseline method, created new evaluation metrics, and introduced new applications and downstream tasks.

Awards

- Jun 2024 **1st place at CVPR'24 challenge**, called Structured Semantic 3D Reconstruction (S23DR), part of Workshop on Urban Scene Modeling: Where Vision Meets Photogrammetry and Graphics.
- Feb 2021 **The Edwards Award**, 2nd place for the best master thesis in the Czech Republic.
- Mar 2020 **First place in Werner von Siemens award for the best master thesis** in the Czech Republic. It is a highly selective, prestigious, well-known award, and the most important award that goes to the best master thesis in the entire Czech Republic.
- Sep 2019 **Best Paper Honorable Mention** at German Conference on Pattern Recognition 2019 [7]. [link].
- Jan 2018 **Valeo scholarship** - two-year scholarship for exceptional master students at CTU sponsored by Valeo (multinational company for automotive driving).
- Nov 2017 **Josef Hlávka's Award** (Cena Josefa Hlávky) – a highly prestigious award for best students and graduates in Czech Republic. Awarded by the oldest Czech foundation established in 1904. [link]
- Aug 2017 **Dean's Award** for an exceptional bachelor thesis. Bachelor's degree with distinctions.

Grants

- 2018 – 2022 **Czech Grant Agency**. I was involved in Czech Grant Agency funding GA18-05360S "Solving inverse problems for the analysis of fast moving objects", which received the **President's Award of the Czech Science Foundation**. This award goes to only one technical grant in Czech Republic every year. The total approved costs were 0.5 million EUR. This grant emerged from my CVPR'17 paper that introduced fast moving objects. I was employed on this project from the very beginning and continued contributing until the end. I am the first author of all core papers on this award-winning project.

Invited talks

- 20.03.2024 Meta Reality Labs – '*Multi-modal Full Body Tracking for XR*' in Zurich.
- 12.10.2023 Deep Layers Workshop – '*Tracking by 3D Model Estimation of Unknown Objects in Videos*' (program) in Brno.
- 10.06.2023 Google Research – '*Estimating Generic 3D Room Structures from 2D Annotations*' in Zurich.
- 14.12.2022 UTIA, Czech Academy of Sciences – '*Deblurring and 3D Reconstruction of Fast Moving Objects*'.
- 21.09.2022 Deep Layers Workshop – '*3D Reconstruction of Motion-blurred Objects*' (program) in Brno.
- 22.09.2019 Honest Guide in Prague – interview with **51K** views showcasing my research on YouTube.
- 10.05.2019 CTU in Prague – invited speaker, talk on '*Fast Moving Objects*', on YouTube.
- 07.07.2018 Eastern European Conference on Computer Vision (EECCV) – invited speaker, talk on '*Detection and Tracking of Fast Moving Objects*' (YouTube, program) in Odessa (Ukraine).
- 23.07.2017 CVPR in Hawaii – demo on fast moving objects.

Teaching

- 2019-2020 **Computer Vision**, Teaching Assistant.
- 2021 **Mixed Reality Lab**, Teaching Assistant.
- 2020-2023 **3D Vision**, Teaching Assistant.
- 2020-2023 **Deep Learning Seminar**, Teaching Assistant.

Supervising

- Nov 2023 **Master thesis**, Rong Zou: Retrieval Robust to Object Motion Blur, in review [19].
- May 2023 **Semester project**, Yiming Zhao: Recovering Blurry Human Body, accepted to ICCV 2023 [15].
- Mar 2022 **Semester project**, Thakur Rajat: Predicting 3D Shape and Texture of Fast Moving Cars.

- Sep 2021 **Master thesis**, Adrian Klaeger: Temporal Super-Resolution of Multiple Fast-Moving Objects.
Jun 2021 **Semester project**, Harish Rajagopal: Improving DeFMO With Learned Losses.
April 2021 **Bachelor thesis**, Julius Fricke: ADMM Algorithm Unrolling: Deblurring and Matting.

Reviewing

- Conferences CVPR, ICCV, ECCV, NeurIPS, ICLR, ICML, 3DV, WACV.
Journals IJCV, PAMI.

Skills

- Technical Machine Learning, Computer Vision, 3D Reconstruction, Differentiable/Neural Rendering, Image Processing, Video Processing, Data Analysis, Representation Learning, Self-supervised Learning, Transfer Learning, NeRF, Gaussian Splatting, Transformers, Diffusion.
Coding Python, C++, C, Matlab, PyTorch, PyTorch3D, TensorFlow.
Personal Complex problem solving, analytical skills, strong communication and collaboration skills, supervising junior researchers and engineers, leading research projects, open-source projects.

Languages

- Fluent **English, Czech, Ukrainian**
Intermediate **German**

Publications (Google Scholar)

- [20] **D. Rozumnyi**, N. Rüegg, O. Sbai, F. Arcadu, Y. Chen, A. Sanakoyeu, M. Kumar Marram Reddy, C. Herold, R. Kips. *XR-MBT: Multi-modal Full Body Tracking for XR through Self-Supervision with Learned Depth Point Cloud Registration*. Submitted to ECCV 2024.
- [19] R. Zou, M. Pollefeys, **D. Rozumnyi**. *Retrieval Robust to Object Motion Blur*. Submitted to ECCV 2024.
- [18] R. Spetlik, **D. Rozumnyi**, J. Matas. *Single-Image Deblurring, Trajectory and Shape Recovery of Fast Moving Objects with Denoising Diffusion Probabilistic Models*. WACV 2024.
- [17] **D. Rozumnyi**, S. Popov, K. Maninis, M. Nießner, V. Ferrari. *Estimating Generic 3D Room Structures from 2D Annotations*. NeurIPS 2023.
- [16] **D. Rozumnyi**, J. Matas, M. Pollefeys, V. Ferrari, M. Oswald. *Tracking by 3D Model Estimation of Unknown Objects in Videos*. ICCV 2023.
- [15] Y. Zhao, **D. Rozumnyi**, J. Song, O. Hilliges, M. Pollefeys, M. Oswald. *Human from Blur: Human Pose Tracking from Blurry Images*. ICCV 2023.
- [14] D. Barath, **D. Rozumnyi**, I. Eichhardt, L. Hajder, J. Matas. *Progressive-X+: Clustering in the Consensus Space*. CVPR 2023. [Online].
- [13] **D. Rozumnyi**, M. Oswald, V. Ferrari, M. Pollefeys. *Motion-from-Blur: 3D Shape and Motion Estimation of Motion-blurred Objects in Videos*. CVPR 2022. [Paper]
- [12] **D. Rozumnyi**, J. Kotera, F. Šroubek, J. Matas. *Tracking by Deblatting*. IJCV 2021. [Paper]
- [11] **D. Rozumnyi**, M. Oswald, V. Ferrari, M. Pollefeys. *Shape from Blur: Recovering Textured 3D Shape and Motion of Fast Moving Objects*. NeurIPS 2021. [Paper]
- [10] **D. Rozumnyi**, J. Matas, F. Šroubek, M. Pollefeys, M. Oswald. *FMODetect: Robust Detection and Trajectory Estimation of Fast Moving Objects*. ICCV 2021. [Paper]
- [9] **D. Rozumnyi**, M. Oswald, V. Ferrari, J. Matas, M. Pollefeys. *DeFMO: Deblurring and Shape Recovery of Fast Moving Objects*. CVPR 2021. [Paper]

- [8] **D. Rozumnyi**, J. Kotera, F. Šroubek, J. Matas. *Sub-frame Appearance and 6D Pose Estimation of Fast Moving Objects*. CVPR 2020. [Paper]
- [7] **D. Rozumnyi**, J. Kotera, F. Šroubek, J. Matas. *Non-Causal Tracking by Deblatting*. In 41th German Conference on Pattern Recognition (GCPR) 2019, Dortmund, Germany. Oral presentation, **Best Paper Honorable Mention**, announced here. [Paper]
- [6] J. Kotera, **D. Rozumnyi**, F. Šroubek, J. Matas. *Intra-frame Object Tracking by Deblatting*. Visual Object Tracking (VOT) Workshop in conjunction with ICCV 2019. [Paper]
- [5] **D. Rozumnyi**, I. Cherabier, M. Pollefeys, M. Oswald. *Learned Semantic Multi-Sensor Depth Map Fusion*. In 3D Reconstruction in the Wild (3DRW) Workshop in conjunction with International Conference on Computer Vision (ICCV) 2019, Seoul, South Korea. [Paper]
- [4] **D. Rozumnyi**. *All-speed Long-term Tracker Exploiting Blur*. Master thesis, Czech Technical University in Prague, 2019. [Paper]
- [3] **D. Rozumnyi**. *Tracking, Learning and Detection over a Large Range of Speeds*. Bachelor thesis, Czech Technical University in Prague, 2017. [Paper]
- [2] **D. Rozumnyi**, J. Kotera, F. Šroubek, L. Novotný, J. Matas. *The World of Fast Moving Objects*. CVPR 2017, Honolulu, Hawaii. [Paper]
- [1] J. Pritts, **D. Rozumnyi**, M. P. Kumar, O. Chum. *Coplanar Repeats by Energy Minimization*. BMVC 2016, York, UK. [Paper]